National Shellfish Sanitation Program

Guide for the Control of Molluscan Shellfish

2007

Section IV. Guidance Documents
Chapter II. Growing Areas

Guide Contents

.06 Shellstock Relay

NSSP guidance documents provide the public health principles supporting major components of the NSSP and its Model Ordinance, and summaries of the requirements for that component. NSSP Model Ordinance requirements apply only to interstate commerce although most states apply the requirements intrastate. For the most up to date and detailed listing of requirements, the reader should consult the most recent edition of the Model Ordinance.

Relaying is the practice of harvesting shellstock from polluted growing areas and placing them in unpolluted bodies of water for a sufficient time for the shellstock to reduce contaminating microorganisms and chemical contaminants to safe levels. When adequate controls are used during the relay process, shellstock resources that would otherwise not be available for human consumption are made safe through natural cleansing, and become accessible to the shellfish industry and the consumer.

Research has shown that shellstock has the ability to purge itself of certain microbial and chemical contaminants when placed in clean saline water. The rate of purging depends on the specific contaminants, species of shellstock, and several environmental factors. As early as 1911, public health officials were investigating the use of natural cleansing through relaying to reduce pathogenic organism levels in oysters (Clem, 1994).

Factors Affecting Natural Cleansing

Shellstock, which is heavily contaminated with microorganisms, may require additional time for natural cleansing. (Metcalf and Stiles, 1968; Canzonier, 1971; Metcalfe, 1979) The length of time required for the cleansing process is influenced by many factors including level of pollution in the shellstock when it is removed from the polluted waters. Roderick and Schneider (1994) have prepared an excellent summary of the current knowledge concerning depuration and relaying of shellstock. Their work identifies four critical factors that affect the physiological activity, pumping rate and behavioral responses of shellstock: water temperature, salinity, dissolved oxygen, and turbidity and suspended solids. Shumway (1996) reports that temperature is the most important factor affecting the eastern oyster. Both temperature and salinity have an important effect on eastern oyster pumping rates, which is important for natural cleansing, with temperature being the most important parameter.

Investigations by marine biologists have confirmed that the physiological activities of shellstock are reduced when the water temperature falls below a certain value. This finding is important because viruses, other pathogens and chemical contaminants cannot be eliminated from shellstock if the shellstock is not actively pumping water. Loosenoff (1958) showed that pumping rates in the eastern oyster rose steadily as water temperature climbed from 8°C to 28°C. Pumping was reported as severely reduced or non-existent below 2°C. Generally investigators agree that the pumping rates in the eastern oyster are reduced at less than 10°C (50°F) (Shumay, 1996).

Cabelli (1971) reported that few coliform organisms were recovered from the northern quahog (*Mercenaria mercenaria*) when the temperature was below 10 °C (50 °F), even though they were collected from heavily polluted waters. Cabelli (1970) also reported the lower limit of the water temperature of the water acceptable for cleansing of soft clams is about 10 °C (50 °F). Burkhardt et al (1992) found that hibernating shellfish become very active after the threshold temperature is reached, and that bacterial and viral indicators accumulate and eliminate differently.

Jaykus *et al* (1994) have prepared a good summary of the current knowledge concerning the viruses associated with shellstock and their elimination through relaying and depuration. In their discussion of the relationship between viruses in shellstock and the coliform indicators used as bacteriological standards, the investigators report "no meaningful relationships have been found between virus presence in clams and oysters and a variety of bacteriological and physicochemical parameters for water and shellfish."

There is considerable information available, particularly for the eastern oyster *(Crassostrea virginica)*, concerning the bioaccumulation and elimination of metals and lipophilic organic contaminants from shellstock (Roesijadi, 1996; Capuzzo, 1996). Pringle (1968) showed that different species of shellstock accumulate varying levels of heavy metals depending upon the pollution level. The chemicals become incorporated into the tissues of the various organs. The rate of release of metals depends on initial levels and species of shellstock. Some metals in some species of shellstock took up to 84 days to deplete. Morrison (1979) reported that the slower depletion of metals as compared to microbiological contaminants indicates that the 14-day cleansing period traditionally used in relaying is not appropriate for removal of metals and their isotopes.

Similarly, most chemicals are not significantly reduced by depuration. It has been found that in soft shell clams, reduction of benzo-a-pyrene to its biological half-life (50% removal) took up to 11 days, depending on temperature and initial level (Jackim, 1977). Removal of over 90% of the polynuclear aromatic (PNA) hydrocarbons took more than over 5 ½ weeks in the same series of experiments. In depuration studies of the pesticide kepone in oysters relayed from the James River to non-kepone contaminated waters of the York and Rappahannock Rivers in Virginia, Bender (1977) found dramatic effects of temperature on the depuration rates. In the summer, the biological half-life of kepone was about one week, while during the winter about 40 days were required for residue levels to decline by the same amount.

Use of containers to hold shellstock during the natural cleansing process may have some effect on rate of contaminant elimination. Quayle (1976) demonstrated rapid purging rates of *E. coli* from Pacific oysters held in wire mesh baskets. Within 48 hours, the level of bacteria in the oysters was the same as the level in oysters harvested from local areas in the approved classification. Becker (1977) reported depth of oysters in baskets was a critical factor. Full baskets did not show effective cleansing in 96 hours, while single layers were effectively cleansed in 48-96 hours.

When use of containers is proposed to hold shellstock during the natural cleansing process, special studies should be made to evaluate the design of the container, and its effect on the rate of natural cleansing. Such studies should be conducted for each container relay operation, each harvesting area, and each relay site.

Relaying Operations

The NSSP recognizes two methods of handling the shellstock during the natural cleansing process: (1) replanting the shellstock directly on the bottom in clean waters; and (2) placing the shellstock in containers (container relaying) which are then floated, suspended from racks, or placed on the bottom in clean waters.

Shellstock may be harvested and transferred for natural biological cleansing from growing areas in the restricted classification, in the closed status of the conditionally approved classification, or in the open status of the conditionally restricted classification. All growing areas used for natural cleansing must be in the approved classification or in the open status of the conditionally approved classification. For more information concerning the classification of growing waters, see the NSSP Guidance Document: *Sanitary Survey and the Classification of Growing Waters* (ISSC/FDA, 2002).

Prior to the initiation of the relaying operation, a decision is required as to whether the purpose of the operation is natural shellstock cleansing to remove microbial or poisonous and deleterious substances or both. Requirements, particularly the time allotted for natural cleansing, may differ depending on the type of contaminant. If the intent of the relay operation is to reduce shellstock microbial contaminants, the shellstock must not also be contaminated with poisonous or deleterious substances that would not be effectively reduced to acceptable levels during the cleansing period. For more information concerning acceptable levels of poisonous and deleterious substances in shellstock, see the NSSP Guidance Document: *FDA Action Levels, Tolerances and Other Values for Poisonous or Deleterious Substances in Seafood* (ISSC/FDA, 2002).

Licensing of each person who harvests shellstock is an important control measure to help protect against contaminated shellstock reaching the consumer and to help maintain accurate source identity records. This is particularly important when harvesters are transporting contaminated shellstock as part of a relay operation. Special permits must be issued to licensed harvesters for taking shellstock from contaminated growing areas and transporting them to other growing areas for the purpose of natural cleansing. The permits must be good for no more than one year, must be issued only for a specific relay operation, and must specify any limitations and conditions for harvesting.

The water quality in the harvest area to which the shellstock are relayed and the bacteriological and/or chemical quality of the relayed lots of shellstock to be subjected to natural cleansing must be verified throughout the relay process. In addition, the identity of the relayed shellstock should be maintained throughout harvesting, transport, processing, packaging, and distribution in the event the shellfish needs to be traced back to its source.

The generally accepted minimum time period for elimination of microbial contaminants from shellstock is 14 days when environmental conditions are suitable for natural cleansing. Longer periods may be required if environmental conditions are not optimum. Shorter time periods may be permitted at some locations or during some periods of the year if there is an adequate study to support the reduced time frame and there is intensive monitoring during the process. Container relaying is particularly amenable to shorter time periods for microbial elimination.

The Authority or the shellfish industry may conduct relay operations. The relay operation must be effectively supervised by the Authority to assure that all the shellstock are actually relayed to harvest areas in the approved classification or in the open status of the conditionally approved classification and sufficiently cleansed. Relay control procedures should preclude any opportunity for shellstock to be inadvertently diverted to sale for human consumption before the natural cleansing process is completed. Controls must be applied to all phases of the operation including initial harvesting, transportation, replanting, the cleansing period, and final harvesting for marketing.

Control procedures must, at a minimum:

(1) Require that the source and species of shellstock being relayed be identified;

(2) Require information concerning:

(a) The quality (bacteriological or chemical) of the water and the shellstock prior to harvest for relay;

(b) The quality of the water and the shellstock indigenous to the area to be used for natural cleansing; and

(c) The quality of the shellstock when the required period of natural cleansing has ended;

(3) Specify the time period of the year when relaying may be conducted;

(4) Use special markings to designate portions of harvest areas where relayed shellstock may be placed for natural cleansing;

(5) Require special harvesting permits for relay operations;

(6) Specify the method of shellstock transportation to the site of natural cleansing, the shellstock deposition method and the method by which different lots of shellstock will be separated during cleansing;

(7) Specify the records to be maintained and filed with the Authority; and

(8) Meet the requirements of the NSSP Model Ordinance.

Control procedures may include monitoring environmental parameters, establishing interagency agreements, imposing quarantine measures, increasing patrols, and developing unique control measures as may be necessary.

A record of water temperature, salinity, and other critical variables must be maintained when it is known that the limiting values of environmental factors may be approached and when minimum relay times are being used.

When container relaying is used, a system of container identification is necessary to locate and avoid re-harvesting of shellfish from containers that have not been left in place long enough for sufficient cleansing.

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